CAAP Quarterly Report

Date of Report: *September 3, 2014*

Contract Number: *DTPH56-13-H-CAAP02*

Prepared for: *DOT*

Project Title: *Scaling and Self-Sensing in Composite Repairs of Corrosion Defects*

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For quarterly period ending: *September 1, 2014*

Business and Activity Section

(a) Generated Commitments

There has been no change in project participants or other contracts.

Supplies Purchased	Cost
General Lab Supplies	$174.02
General Lab Supplies	$221.72
Blasting supplies	$155.01
Electronics Supplies	$90.25
Pressure sensor	$161.78
Strain gages	$333.87
General Lab Supplies	$62.79
General Supplies	$209.89
Lab Supplies	$38.79
Machining Inserts	$16.65
Replacement accumulator	$123.58

(b) Status Update of Past Quarter Activities

In the past quarter (starting June 1, 2014), we have completed the following research planning activities

1. Performed initial control testing on small-scale sample
2. Made contact with donor for new large-scale specimen.
3. Confirmed operation and performance of the multi-vessel fatigue system
4. Performed finite element modeling of patch and full-encirclement repairs.

The major technical accomplishment for this quarter was the development of a finite element model for the investigation of the mechanical performance of the patch and full-encirclement repairs. This is helping us determine expected performance for the small-scale samples. Additionally, we are using the finite element model to determine the exact depth of the flaw that will be repaired by the participating companies. Our initial plans were to proceed with an 80% wall-loss sample, but there was some hesitation on the part of the companies to begin with such an aggressive sample design. Since this period we have been able to investigate the stress state of the substrate repair using the finite element models and have a better understanding of how the flaws will perform once repaired.

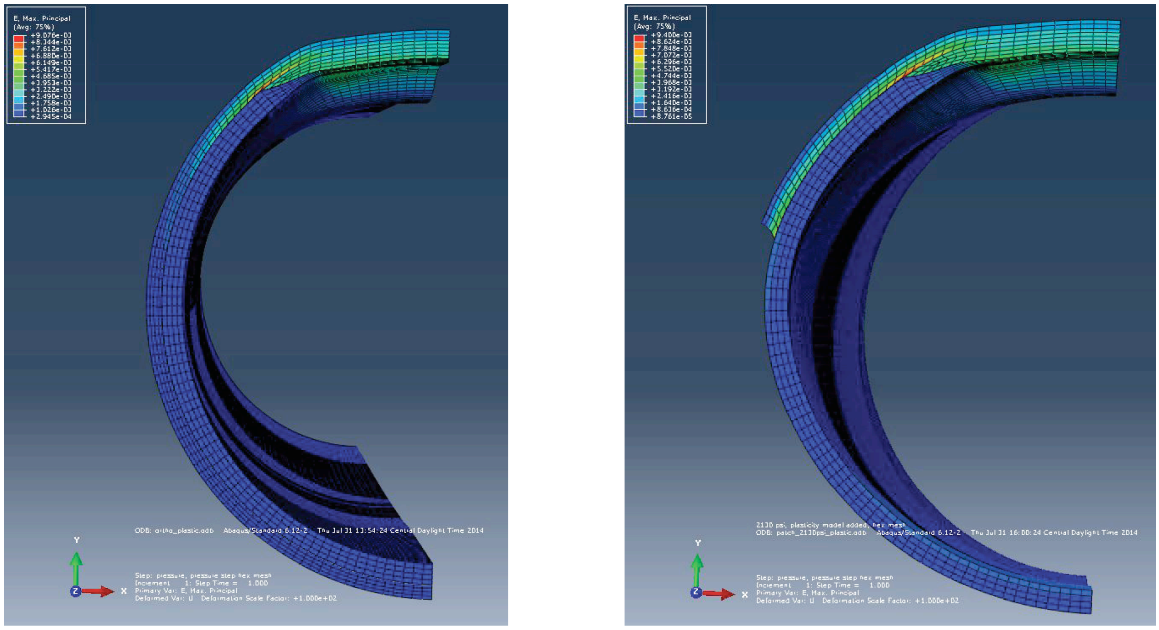

Figure 1: Finite element simulation results for a full-encirclement and patch repair of a small-scale vessel.

Figure 1 shows the results of a finite element simulation for both repair types. The patch repair was not tapered; we expect that most of the installers will install using a tapered edge to reduce stress concentrations. The substrate strains for both repairs are similar however, the strain distribution in the composite repairs are different. Deformation of the base pipe also is slightly different due to the asymmetric nature of the patch pipe repairs. Fatigue performance estimated using experimental data from the literature implies that we should expect a few tens of thousands of cycles before substrate failure. The repair was a 0.25 in carbon/epoxy composite with material properties taken from literature sources. We are using this model to help us understand the interaction between the repairs and the substrate pipe. An additional goal of this study is to provide some insight into stress and strain states of the substrates under these composite repairs.

Other, technical achievements include initial testing on the fatigue system to ensure correct performance. We had to add a small accumulator to the fatigue system to minimize pressure spikes. This modification appears to have solved this concern.

(c) Description of any Problems/Challenges

In the last report, we were determining if the 60 in diameter vessel that was offered by Phillips 66 would be feasible for use in this project. We determined that we could cycle the vessel at an appropriate rate and were moving forward with acquisition of the vessel. Unfortunately, the vessel had been scrapped, which left us with no large-scale test option. Since that period we have been able to source a new vessel from a local company, Superior Pipeline. They have offered a 36 in vessel and, potentially, a 42 in vessel. We are working with them and expect to take delivery of this vessel in the next quarter.

A draft small-scale test plan was sent to the manufacturers participating in this project in early July. Since that period, there has been much discussion about the flaw depth and the required repair thickness and approaches. We have not yet completely finalized the test plan and are now about 1 month behind schedule for the install and test. The PI will attend the ASME PCC meeting in early September, along with all participating companies. We expect that all remaining concerns will be resolved at this meeting and installs will begin at the end of September.

(d) **Planned Activities for the Next Quarter** –

Planned activities for the next quarter include the following

1. Finalization of small scale flaw design based on control specimen fatigue behavior
2. Sample manufacture and repair installs
3. Complete a significant portion of the small-scale fatigue testing.
4. Begin fabrication and preparation for large scale testing.